CROSS REFERENCE SEARCH ROOM
XR 2,698,909

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PIEZOELECTRIC CRYSTAL PLATE

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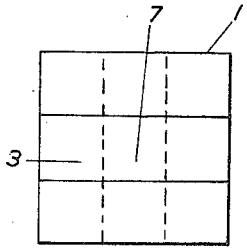


FIG. 1.

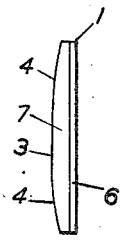


FIG. 2.

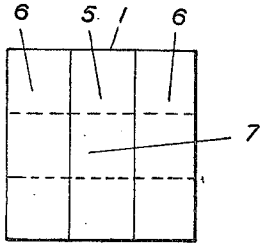


FIG. 3.

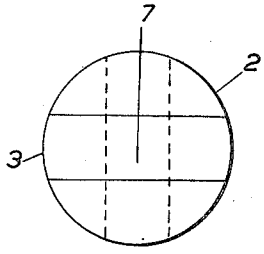


FIG. 4.

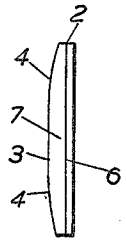


FIG. 5.

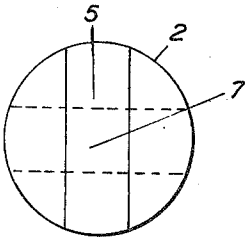


FIG. 6.

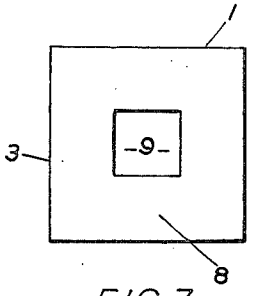


FIG. 7.

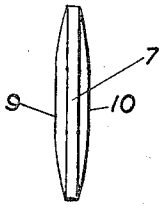


FIG. 8.

Inventors
EDWARD S. WRIGHT
ALEXANDER C. ROBERTSON
By [signature]
Attorney

United States Patent Office

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PIEZOELECTRIC CRYSTAL PLATE

Edward Stainsby Wright and Alexander Christie Robertson, London, England, assignors to International Standard Electric Corporation, New York, N. Y.

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3 Claims. (Cl. 310—9.5)

This invention relates to piezoelectric crystal plates intended for vibration in a thickness shear mode.

It is the object of the present invention to reduce or eliminate modes of vibration of such crystal plates other than the thickness shear mode, and to reduce or eliminate the inharmonic overtone vibrations in the thickness shear mode at frequencies adjacent to the desired frequency.

It is already known to reduce or eliminate unwanted modes by grinding two opposed major electrode surfaces on a circular quartz blank to form a double convex contour.

The present invention provides a piezo crystal plate which is more economic to manufacture, but which effectively exhibits only the desired mode of vibration.

According to the present invention each of two opposed major surfaces of a crystal plate of uniform thickness is ground on the interior face of a cylindrical grinding tool leaving an unground portion to which an electrode is applied.

The invention will be understood from the following description of embodiments thereof taken in conjunction with the accompanying drawings, in which

Figs. 1, 2 and 3 show in front, side and rear elevation respectively a piezoelectric crystal plate of square contour, in accordance with one embodiment of the invention.

Figs. 4, 5 and 6 are corresponding views of a piezoelectric crystal plate of circular contour in accordance with the invention.

And Figs. 7 and 8 are front and side elevations respectively of a piezoelectric crystal plate in accordance with a further embodiment of the invention. Referring to the drawings, a crystal plate **1**, Figs. 1, 2 and 3, or **2**, Figs. 4, 5 and 6, is first prepared in the usual manner as a parallel face plate, e. g. in the case of quartz, by grinding the opposed major faces to optical flatness. In order to eliminate modes other than the thickness shear mode, one face of the plate, e. g. that shown in Fig. 1 or Fig. 4 is ground by a cylindrical grinding tool in one direction only so as to leave on that face a longitudinal strip **3**, which is unground, having longitudinal chamfered edges **4**, Figs. 2 and 5. The opposite face of the plate, viz that shown in Figs. 3 and 6 is then ground by a similar tool in a direction at 90° to the direction of grinding of the first mentioned face, so as to leave an unground longitudinal strip, **5** which lies at 90° to the strip **3** and has chamfered longitudinal edges **6**. There is then a central portion **7** of the plate that has a square flat face on each side of the plate and the electrodes are applied to these square flat faces.

It is to be understood that the thickness of the crystal plates in relation to the area thereof, and the amount of chamfering has been exaggerated in the drawings for the sake of showing clearly the final shape of the plate. The chamfering necessary to achieve the object of the invention needs in practice only to be to the extent of a few microns.

Since unwanted modes of vibration are very much reduced by the process above described, the areas of the major surfaces of the crystal plate **1** or **2** can be made smaller for a given frequency than heretofore. These areas can be still further reduced by carrying the invention a stage further, as shown in Figs. 7 and 8. One face of the crystal plate **1** is first ground as before to leave an unground longitudinal strip **3**. The plate is then rotated through 90° and a second similar grinding operation performed on the same face, in such a way that a central longitudinal strip **8** is unaffected by the second grinding operation. As a result of these two operations only a central square **9** of the major face is left unground.

Two similar grinding operations are then performed on the opposite major face, the two directions of grinding being respectively parallel to the two directions of grinding of the first face, so that only a central square **10** of the second major face is left unground. The result is a crystal plate with a central portion **7** having square opposite plane surfaces **9** and **10**. The plate is chamfered away from this central portion in two directions on each of the faces. Again the amount of chamfering need only be a few microns and has been exaggerated in the drawing.

By using this last described embodiment of the invention it has been possible to provide a crystal plate in a size of less than 12 mm. square but having a fundamental natural frequency of less than 2 mc./s. in the thickness shear mode. It is to be understood that this last mentioned form of the invention may equally well be applied to a crystal plate having a circular contour.

A crystal plate in accordance with the invention may be mounted in any known manner adjacent its periphery or its edges and for the purpose of making contact between each electrode and a suitable connecting and supporting member a coating may be applied on each of the opposite faces and extending from the central electrode area to the periphery of the face, such as a corner of a plate having square faces.

While the principles of the invention have been described above in connection with specific embodiments, and particular modifications thereof, it is to be clearly understood that this description is made only by way of example and not as a limitation on the scope of the invention.

What we claim is:

1. A piezo-electric crystal plate for vibration in a thickness shear mode, the plate having top and bottom surfaces, and an edge surface, the central part of the top and bottom surfaces being defined by a flat elongated strip extending across each of said surfaces and symmetrically located thereon, the area on either side of said strip consisting of a cylindrical surface extending from said strip to said edge surface, said strips lying in parallel planes and the elongated dimensions of said strips being oriented at 90° with respect to each other.

2. The crystal according to claim 1 wherein the top and bottom surfaces of said crystal plate are substantially circular in shape.

3. The crystal according to claim 1, wherein the top and bottom surfaces of said crystal are substantially rectangular in shape.

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